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Incorporating homeowners' preferences of heating technologies in the UK TIMES model

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# 1 Incorporating Homeowners' Preferences of Heating Technologies in the 2 UK TIMES Model

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## 8 Highlights

- 9 ● Transition pathways that do not consider preferences might be misleading
- 10 ● Transitions driven by preferences alone cannot decarbonise heating  
11 cost-effectively
- 12 ● Heat pumps and electric heaters are deployed less when preferences are  
13 considered
- 14 ● District heating could provide flexibility for decarbonisation
- 15 ● Low-carbon hydrogen is crucial to reduce GHG emission from residential heating

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## 17 Abstract

18 Hot water and space heating account for about 80% of total energy  
19 consumption in the residential sector in the UK. It is thus crucial to decarbonise  
20 residential heating to achieve UK's 2050 greenhouse gas reduction targets. However,  
21 the decarbonisation transitions determined by most techno-economic energy  
22 system models might be too optimistic or misleading for relying on cost minimisation  
23 alone and not considering households' preferences for different heating  
24 technologies. This study thus proposes a novel framework to incorporate  
25 heterogeneous households' (HHs) preferences into the modelling process of the UK  
26 TIMES model. The incorporated preferences for HHs are based on a nationwide  
27 survey on homeowners' choices of heating technologies. Preference constraints are  
28 then applied to regulate the HHs' choices of heating technologies to reflect the  
29 survey results. Consequently, compared to the least-cost transition pathway, the  
30 preference-driven pathway adopts heating technologies gradually without abrupt  
31 increases of market shares. Heat pumps and electric heaters are deployed much less  
32 than in the cost optimal result. Extensive district heating using low-carbon fuels and  
33 conservation measures should thus be deployed to provide flexibility for  
34 decarbonisation. The proposed framework can also incorporate preferences for  
35 other energy consumption technologies and be applied to other linear  
36 programming-based energy system models.

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